Data Distribution

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This presentation:

1. **Presents data distribution from the perspective of Earth observations and the end user**
2. **Reviews problems associated with SAR data distribution**
3. **Discusses future data distribution techniques**

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Representative Requirements

Typical End User Requirements which drive distribution technology

	Timeliness	Resolution	Data transfer rate
Near real time	< 6hr	>200m	20 images/day
Scientific research	Weeks to Months	100m	200 images/day

Data Distribution Problems

- Raw Signal Data
  - Huge data volume- Terabytes per year
  - Significant expense copying High Density Digital Tapes ($250,000/yr)
  - Different tape formats (recorders) between many data distributors
- Images
  - Large data volume for global studies
  - Nonstandard format
  - High demand, large volume precludes data networks
  - Prior to ERS-1, JERS-1, Magellan user base was small compared to Landsat/SPOT
- Geophysical Products
  - Tend to be restricted to expert users

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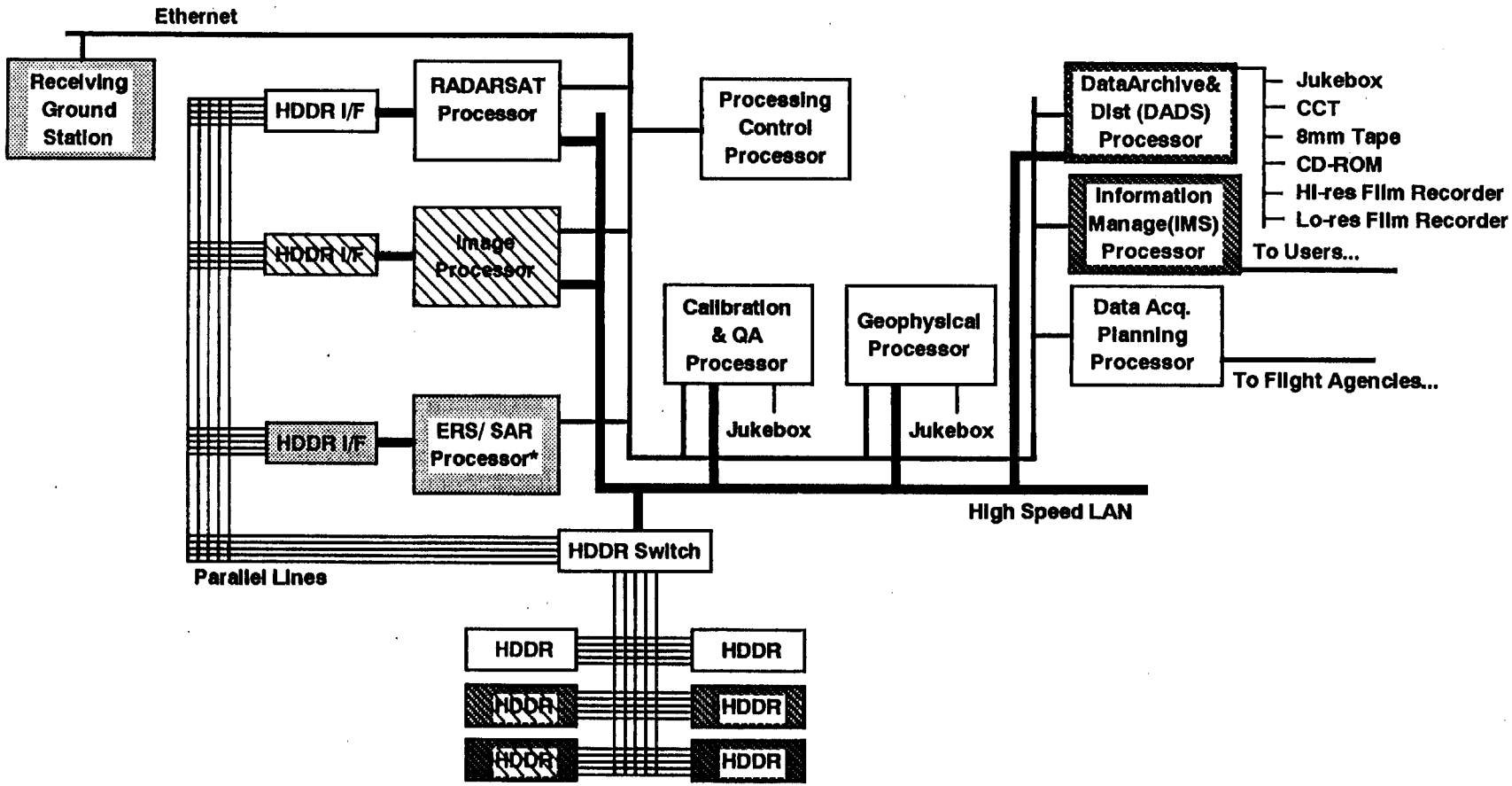
Multimission SAR Processing System Architecture



HDDR-High Density Digital Recorder

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Data Product Formats

- A standard data format improves data product usability by:
  1. Standardizing image annotation structures
  2. Providing an international standard
  3. Promoting data usability with standard software data packages

- For Earth Observing Satellites:
- CEOS SAR computer compatible tape is the output product format standard for:
  - The Alaska SAR Facility
  - SIR-C
  - National flight agencies, e.g., for ERS-1, JERS-1 distribution

- CEOS structure is designed for computer compatible tapes (based on LandSat tapes)

- Hierarchical Data Format (HDF) For SAR
  - Improves SAR usability through compatibility
    - Large Earth science user community for data in HDF structure
    - Facilitates intersensor comparison, global model comparison
  - Preferred format for the Earth Observing System Data and Information System Version 0 (and probably for versions in the late 1990's)
  - HDF is supported by a large software tool base for science data visualization
  - Translator developed by the Alaska SAR Facility for converting CEOS to HDF

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CEOS Format

- VOLUME DIRECTORY FILE

  Volume Descriptor Record
  File Pointer Records
  Text Records

- SAR LEADER FILE

Data Set Summary Record	mission, data acquisition, sensor, processing parameters
Map Projection Record	geometric characteristics of image data
Platform Position Data Record	orbit parameters, spacecraft position and velocity vectors
Attitude Data Record	attitude and attitude rate
Radiometric Data Record	tables relating data numbers to backscatter coefficients
Radiometric Compensation Record	radiometric correction vectors
Data Quality Summary Record	data quality analysis results summary
Data Histogram Record	data histograms
Range Spectra Record	range spectra
Radar Parameter Update Record	radar parameters (gain, DWP) change
Detailed Processing Parameters	mission specific processing parameters

- SAR IMAGERY OPTION FILE

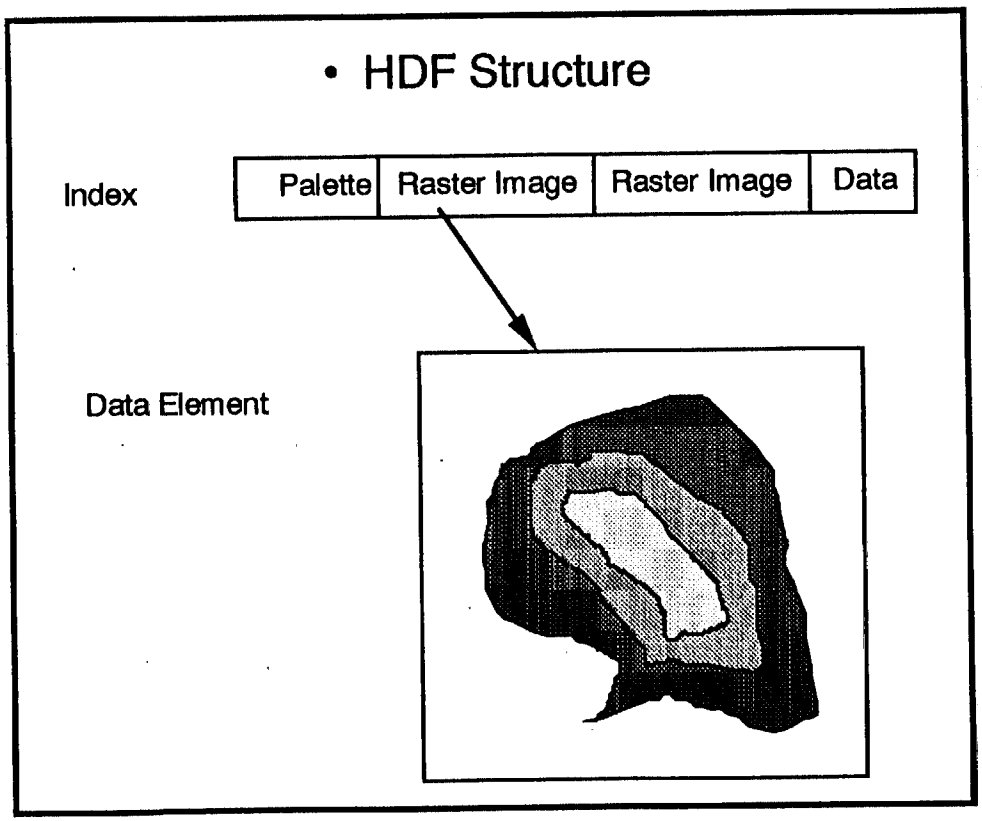
  File Descriptor Record
  SAR Data Record (Image or Signal Data) with line ID (prefix, suffix not used)

- NULL VOLUME DIRECTORY FILE

  Null Volume Descriptor Record

HDF Format

- HDF was developed by the National Center for Supercomputer Applications (NCSA)
- HDF provides:
  - A format for the exchange of data in distributed computing environments
  - Support for scientific data; large data sets, data descriptions, sharable data
  - Public domain software; data analysis, visualization, computer communications
- Approximately 100,000 users



Information Objects	
Raster image -	8-bit, 24-bit
Palette-	Look-up table
Data-	Arrays
Annotation-	Text (metadata)
Vsets-	Grouped data

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High Density Media Comparison

- High density media for the distribution of raw signal data

Media Format	Drive	Read/Write	Data Capacity (Bytes)	Access Time (ms)	Search Time (s)	Transfer Rate MBps	Drive Cost ($K)	Media Cost	Availability
Optical paper, 35mm paper, length: 880 m, 12 in diam. reel	New design reel-to-reel	Write Once Read Many (WORM) Laser, non-contact	$1x10^{12}$	28	60	3	225	$5K/reel $0.005/MB	In operation
Optical paper, 0.5 in tape, length: 255, IBM 3480 cartridge	Modified IBM 3480	Write Once Read Many (WORM) Laser, non-contact	$50 x10^{9}$ plus 50 cart. jukebox	600 (to 200 MB)	15	3	20	$250/cartridge $0.005/MB	1992
HDDT, cartridge	Rotary scan	Read/Write	$45x10^{9}$	1	300	1-12	200	$500/cartridge $0.01/MB	In operation
CCT, 0.5 in reel		Read/Write	$120x10^{6}$	10	150	0.4	30	$12/tape $0.1/MB	In operation
Dig. Opt Disk, 12 in		WORM	$6x10^{9}$	60	0.060	0.2	25	$300/platter $0.15/MB	In operation
Magnetic disk		Read/Write	$1x10^{9}$	15	0.030	1	5	$5k/drive $5/MB	In operation

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Distribution Media

- Distribution media for multilook detected and geophysical data products

1978 (Seasat)	1993	
Black/white Strips 50 μm resolution	Black/white prints Frames (scene) 8k x 8k pixels 25 μm resolution	Color Prints 1.5 x 2k pixels 80 μm resolution
Computer Compatible Tape 50 MB/tape 200 KBps transfer rate	8mm magnetic tape 2 or 5 GB capacity 250 KBps transfer rate CD-ROM 600 MB capacity 200 KBps transfer rate	Computer Compatible Tape 100 MB/tape 400 KBps transfer rate Data networks 300 KBps transfer rate

Data Communications Networks

Current Networks Utilized For SAR Data Transfer

- NASA Science Network
- Earth Observing System Data and Information System Version 0 Network

- Performance
  - T1 56 Kbps
  - T3 1.5 Mbps

- Key to network utilization
  - Distribute products derived from SAR images, e.g., ice motion fields, vegetation index
    - Reduces data volume,
    - Increases SAR data usability and user base
  - Data compression for browse image transfer

- Near real-time applications
  - DOMSAT with image data compression (1 Mbps data channel)

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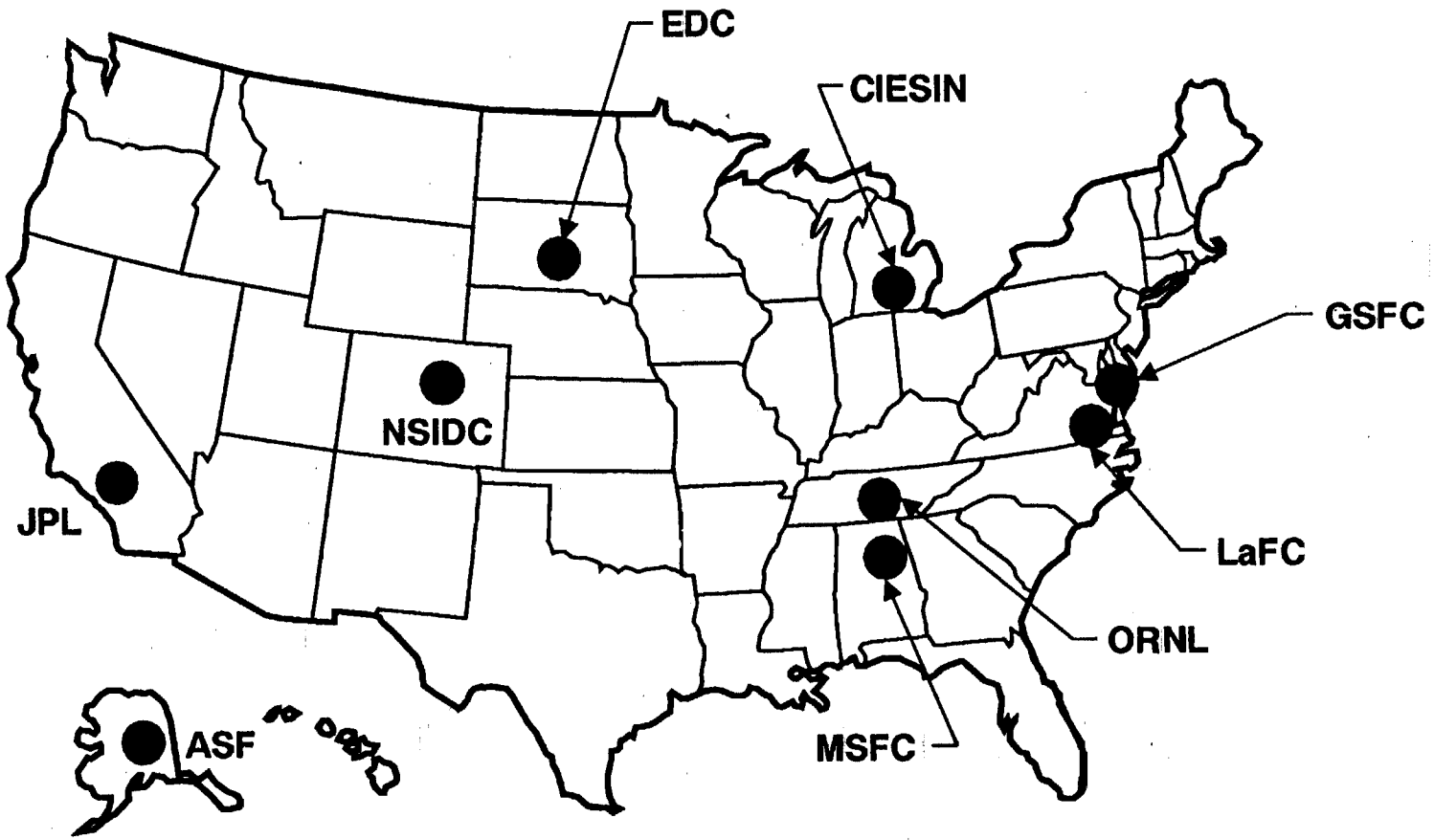
EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS)

DISTRIBUTED ACTIVE ARCHIVE CENTERS (DAACs)



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EOSDIS ARCHITECTURE

EOSDIS-SPONSORED DATA CENTERS*

EARTH SCIENCE DAACs

CENTER	INITIAL SYSTEMS	AREAS OF INTEREST	EOS AND OTHER MISSIONS/INSTRUMENTS
GSFC GODDARD SPACE FLIGHT CENTER	NCDS, PLDS, CDDIS	CLIMATE, METEOROLOGY, STRATOSPHERE, OCEAN BIOLOGY, AND GEOPHYSICS; AVHRR AND TOVS PATHFINDER DATA SETS	MODIS-N, AIRS, MHS, AMSU, SeaWIFS, GLRS-A, HIRDLS, TOMS, AND TMI
LaRC LANGLEY RESEARCH CENTER	ERBE PROCESSING	CLOUDS, RADIATION, AEROSOLS, AND TROPOSPHERIC CHEMISTRY	CERES, ERBE, MOPITT, MISR, EOSP, SAGE, AND TES
EDC EROS DATA CENTER	GLIS, LANDSAT PROCESSING	LAND PROCESSES	ASTER, HIRIS, SAR (LAND), LANDSAT (MSS AND TM), AND AVHRR
UAF UNIVERSITY OF ALASKA-FAIRBANKS	ASF SYSTEM	SAR IMAGERY OF ICE, SNOW, AND SEA SURFACE	ERS-1, JERS-1, ERS-2, RADARSAT; AND ONGOING ROLE AS GROUND STATION

*EOSDIS Handbook, 1992

EOSDIS ARCHITECTURE (Cont'd)

EOSDIS-SPONSORED DATA CENTERS*

CU UNIVERSITY OF COLORADO	CDMS	POLAR OCEANS AND ICE	SMMR, SSM/I, AND OLS
JPL JET PROPULSION LABORATORY	NODS	PHYSICAL OCEANOGRAPHY	TOPEX/POSEIDON, NSCAT, STIKSCAT, AND ALT
MSFC MARSHALL SPACE FLIGHT CENTER	WetNet	HYDROLOGIC CYCLE; SSM/I PATHFINDER DATA SETS	MIMR, TMI, TRMM PR, LIS, AND SSM/I
ORNL OAK RIDGE NATIONAL LABORATORY	TGDDIS	TRACE GAS FLUXES	GROUND-BASED DATA RELATING TO FLUXES OF TRACE GASES (e.g., CO_2, CH_4)
SOCIO-ECONOMIC DATA AND APPLICATIONS CENTER			
CDRC CIESIN DATA AND RESEARCH CENTER	—	HUMAN DIMENSIONS OF GLOBAL CHANGE AND POLICYMAKING APPLICATIONS	SOCIO-ECONOMIC DATA

*EOSDIS Handbook, 1992

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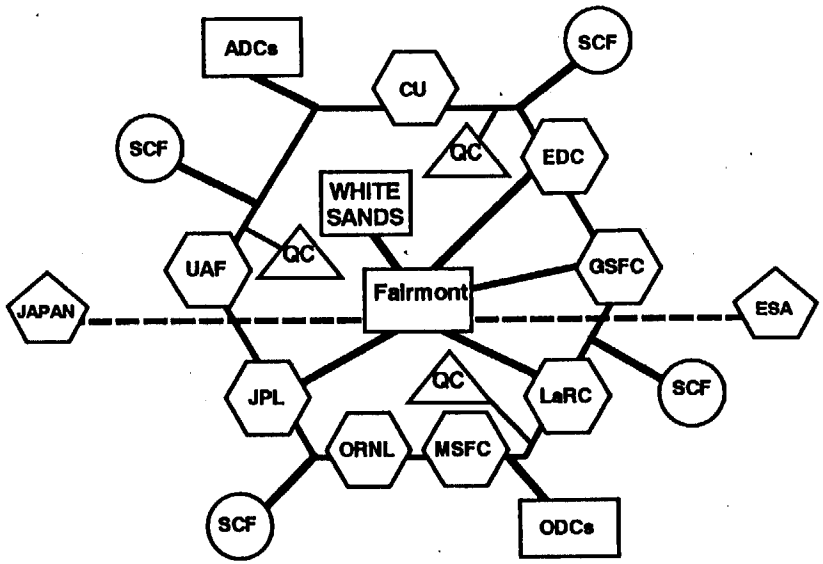
EOSDIS ARCHITECTURE

NETWORK STRATEGY*



ODCs = OTHER DATA CENTERS NON-INTEROPERABLE WITH DAACs

ADCs = AFFILIATED DATA CENTERS INTEROPERABLE WITH DAACs (NOAA/NESDIS, NOAA/UNIVERSITY OF WISCONSIN.....)

SCF = USERS SUPPORTED BY GENERAL SCIENCE NETWORKS (NSF INTERNET, NSN, NREN...)

DAAC = DISTRIBUTED ACTIVE ARCHIVE CENTER

QC = QUALITY CONTROL SCIENCE COMPUTING FACILITIES

Complex = FACILITIES FOR LEVEL 0 AND 1 DATA HANDLING

EOSDIS INTERNAL NETWORKS

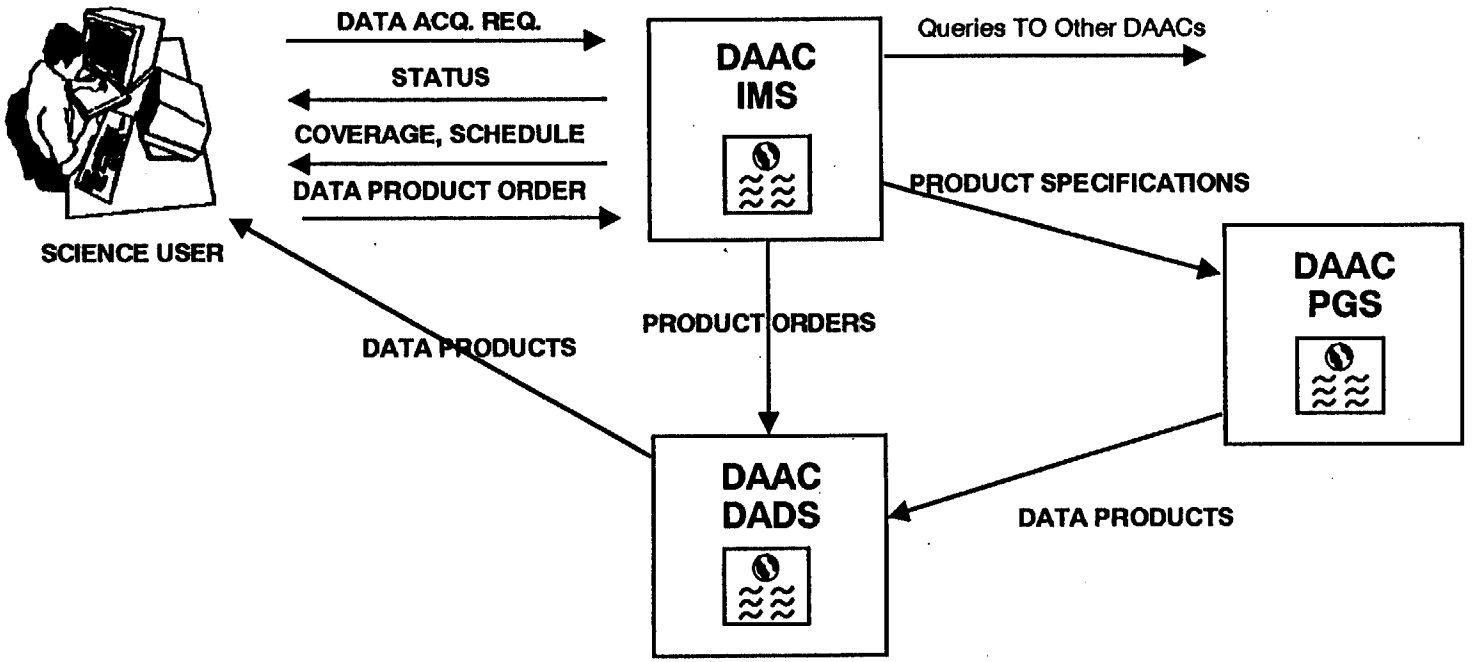
INTERNAL NETWORKS LEVEL OF SERVICE

EOSDIS EXTERNAL NETWORKS

EXTERNAL NETWORKS LEVEL OF SERVICE

*from EOSDIS Handbook, 1992

EOSDIS SCIENCE USER INTERFACE



EOSDIS - Earth Observing System Data and Information System
DAAC - Distributed Active Archive Center
IMS - Information Management System
PGS - Product Generation System
DADS - Data Archive and Distribution System